TEST REPORT

Dt&C

Dt&C Co., Ltd.
42, Yurim-ro, 154Beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea, 17042
Tel : 031-321-2664, Fax : 031-321-1664

1. Report No : DRRFCC2301-0001
2. Customer
   - Name : LG Electronics USA
   - Address : 111 Sylvan Avenue North Building Englewood Cliffs New Jersey United States 07632
3. Use of Report : FCC Class II permissive change
4. Product Name / Model Name : RF Module / LGSBWAC93
   FCC ID : BEJLGSBWAC93
5. FCC Regulation(s) : CFR 47 Part 2 subpart 2.1093
   Test Method Used : IEEE 1528-2013, IEC/IEEE 62209-1528
   FCC SAR KDB Publications (Details in test report)
6. Date of Test : 2022.08.31 ~ 2022.09.06
7. Location of Test : ☒ Permanent Testing Lab ☐ On Site Testing
8. Testing Environment : Refer to attached test report
9. Test Result : Refer to attached test report.

The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
This test report is not related to KOLAS accreditation.

Affirmation	Tested by Name : YeJin Seo (Signature)	Technical Manager Name : HakMin Kim (Signature)

2023 . 01 . 05 .

Dt&C Co., Ltd.

If this report is required to confirmation of authenticity, please contact to report@dtnc.net

Test Report Version

Test Report No.	Date	Description	Tested by	Reviewed by
DRRFCC2301-0001	Jan. 05, 2023	Initial issue	YeJin Seo	HakMin Kim

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1. DESCRIPTION OF DEVICE

1.1 General Information

EUT type	Flat Panel Digital X-ray Detector			
FCC ID	BEJLGSBWAC93			
Model Name	LGSBWAC93			
Product Marketing Name	LGSBWAC93			
Hardware Version Identification Number	TWCM-K504D			
Firmware Version Identification Number	MT7668_V1.0			
Host Marketing Name	14HQ901G-B, 14HQ701G-B, 14HQ721G-B, 14HQ901G, 14HQ701G, 14HQ721G			
Equipment serial no.	Identical prototype			
FCC & ISED MRA Designation No.	KR0034			
ISED#	5740A			
Mode(s) of Operation	2.4 GHz W-LAN(802.11b/g/n HT20/n HT40), 5 GHz W-LAN (802.11a/n HT20/n HT40/ac VHT20/ ac VHT40/ ac VHT80)			
TX Frequency Range	**Band**	**Mode**	**Bandwidth**	**Frequency**
	2.4 GHz W-LAN	802.11b/g/n	HT20	2 412 MHz ~ 2 472 MHz
		802.11n	HT40	2 422 MHz ~ 2 452 MHz
	5.2 GHz W-LAN	802.11a/n/ac	HT20/VHT20	5 180 MHz ~ 5 240 MHz
		802.11n/ac	HT40/VHT40	5 190 MHz ~ 5 230 MHz
		802.11ac	VHT80	5 210 MHz
	5.3 GHz W-LAN	802.11a/n/ac	HT20/VHT20	5 260 MHz ~ 5 320 MHz
		802.11n/ac	HT40/VHT40	5 270 MHz ~ 5 310 MHz
		802.11ac	VHT80	5 290 MHz
	5.6 GHz W-LAN	802.11a/n/ac	HT20/VHT20	5 500 MHz ~ 5 720 MHz
		802.11n/ac	HT40/VHT40	5 510 MHz ~ 5 710 MHz
		802.11ac	VHT80	5 530 MHz, 5 690 MHz
	5.8 GHz W-LAN	802.11a/n/ac	HT20/VHT20	5 745 MHz ~ 5 825 MHz
		802.11n/ac	HT40/VHT40	5 755 MHz ~ 5 795 MHz
		802.11ac	VHT80	5 775 MHz
RX Frequency Range	2.4 GHz W-LAN	802.11b/g/n	HT20	2 412 MHz ~ 2 472 MHz
		802.11n	HT40	2 422 MHz ~ 2 452 MHz
	5.2 GHz W-LAN	802.11a/n/ac	HT20/VHT20	5 180 MHz ~ 5 240 MHz
		802.11n/ac	HT40/VHT40	5 190 MHz ~ 5 230 MHz
		802.11ac	VHT80	5 210 MHz
	5.3 GHz W-LAN	802.11a/n/ac	HT20/VHT20	5 260 MHz ~ 5 320 MHz
		802.11n/ac	HT40/VHT40	5 270 MHz ~ 5 310 MHz
		802.11ac	VHT80	5 290 MHz
	5.6 GHz W-LAN	802.11a/n/ac	HT20/VHT20	5 500 MHz ~ 5 720 MHz
		802.11n/ac	HT40/VHT40	5 510 MHz ~ 5 710 MHz
		802.11ac	VHT80	5 530 MHz, 5 690 MHz
	5.8 GHz W-LAN	802.11a/n/ac	HT20/VHT20	5 745 MHz ~ 5 825 MHz
		802.11n/ac	HT40/VHT40	5 755 MHz ~ 5795 MHz
		802.11ac	VHT80	5 775 MHz

Equipment Class	**Band**	**Reported SAR 1 g SAR (W/kg)**	
		SISO (Head/Body)*	**MIMO (Head/Body)***
DTS	2.4 GHz W-LAN	< 0.10	< 0.10
U-NII-1	5.3 GHz W-LAN	< 0.10	< 0.10
U-NII-2A	5.3 GHz W-LAN	< 0.10	< 0.10
U-NII-2C	5.6 GHz W-LAN	**< 0.10**	< 0.10
U-NII-3	5.8 GHz W-LAN	< 0.10	< 0.10

FCC Equipment Class	Digital Transmission System(DTS) Unlicensed National Information Infrastructure (UNII)
Date(s) of Tests	2022.08.31 ~ 2022.09.06
Antenna Type	Internal Type Antenna
Note	* This device can be used on the user's head and body, and the test position is the same in the flat phantom, so it was tested only once. Please refer to the test photo.

1.2 Power Reduction for SAR

There is no power reduction used for any band/mode implemented in this device for SAR purposes.

1.3 Nominal and Maximum Output Power Specifications

The Nominal and Maximum Output Power Specifications are in section 7 of this test report.

1.4 Guidance Applied

- IEEE 1528-2013
- IEC/IEEE 62209-1528
- FCC KDB Publication 248227 D01v02r02 (802.11 Wi-Fi SAR)
- FCC KDB Publication 447498 D01v06 (General RF Exposure Guidance)
- FCC KDB Publication 648474 D04v01r03 (Handset SAR)
- FCC KDB Publication 690783 D01v01r03 (SAR Listings on Grants)
- FCC KDB Publication 865664 D01v01r04 (SAR Measurement 100 MHz to 6 GHz)
- FCC KDB Publication 865664 D02v01r02 (RF Exposure Reporting)

1.5 Device Serial Numbers

The serial numbers used for each test are indicated alongside the results in Section 9.

1.6 FCC & ISED MRA test lab designation no. : KR0034

2. INTROCUCTION

The FCC and Industry Canada have adopted the guidelines for evaluating the environmental effects of radio frequency (RF) radiation in ET Docket 93-62 on Aug. 6, 1996 and Health Canada Safety Code 6 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices.

The FCC has adopted the guidelines for evaluating the environmental effects of radio frequency radiation in ET Docket 93-62 on Aug. 6, 1996 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices. The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz. The measurement procedure described in IEEE/ANSI C95.3-2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave is used for guidance in measuring SAR due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields," NCRP Report No. 86 NCRP, 1986, Bethesda, MD 20814. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

SAR Definition

Specific Absorption Rate (SAR) is defined as the time derivative (rate) of the incremental energy (dU) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (ρ) It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Fig. 3.1)

$$SAR = \frac{d}{dt}\left(\frac{dU}{dm}\right) = \frac{d}{dt}\left(\frac{dU}{\rho dv}\right)$$

Fig. 2.1 SAR Mathematical Equation

SAR is expressed in units of Watts per Kilogram (W/kg).

$$SAR = \frac{\sigma \cdot E^2}{\rho}$$

where:

σ = conductivity of the tissue-simulating material (S/m)

ρ = mass density of the tissue-simulating material (kg/m^3)

E = Total RMS electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relations to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.

3. DOSIMETRIC ASSESSMENT

3.1 Measurement Procedure

The evaluation was performed using the following procedure compliant to FCC KDB Publication 865664 D01v01r04 and IEEE 1528-2013:

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01r04 (See Table 3.1) and IEEE1528-2013.

2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1 g/10 g cube evaluation. SAR at this fixed point was measured and used as a reference value.

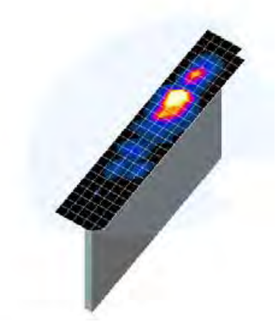

Figure 3.1
Sample SAR Area Scan

3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01r04 (See Table 3.1) and IEEE 1528-2013. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):

   a. SAR values at the inner surface of the phantom are extrapolated from the measured values along the line away from the surface with spacing no greater than that in Table 3.1. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).

   b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1 g or 10 g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the “Not a knot” condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.

   c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5 %, the SAR test and drift measurements were repeated.

<table>
<tr><td colspan="3"></td><td>$\leq$ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 mm ± 1 mm</td><td>$\frac{1}{2} \cdot \delta \cdot \ln(2)$ mm ± 0.5 mm</td></tr>
<tr><td colspan="3">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td colspan="3" rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</td><td>$\leq$ 2 GHz: $\leq$ 15 mm
2 – 3 GHz: $\leq$ 12 mm</td><td>3 – 4 GHz: $\leq$ 12 mm
4 – 6 GHz: $\leq$ 10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be $\leq$ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>$\leq$ 2 GHz: $\leq$ 8 mm
2 – 3 GHz: $\leq$ 5 mm*</td><td>3 – 4 GHz: $\leq$ 5 mm*
4 – 6 GHz: $\leq$ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>$\leq$ 5 mm</td><td>3 – 4 GHz: $\leq$ 4 mm
4 – 5 GHz: $\leq$ 3 mm
5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>$\leq$ 4 mm</td><td>3 – 4 GHz: $\leq$ 3 mm
4 – 5 GHz: $\leq$ 2.5 mm
5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$ mm</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>$\geq$ 30 mm</td><td>3 – 4 GHz: $\geq$ 28 mm
4 – 5 GHz: $\geq$ 25 mm
5 – 6 GHz: $\geq$ 22 mm</td></tr>
<tr><td colspan="5">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details.
* When zoom scan is required and the <u>reported</u> SAR from the area scan based 1-g SAR estimation procedures of KDB Publication 447498 is $\leq$ 1.4 W/kg, $\leq$ 8 mm, $\leq$ 7 mm and $\leq$ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

Table 3.1 Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01r04*

4. TEST CONFIGURATION POSITIONS FOR HANDSETS

4.1 Device Holder

The device holder is made out of low-loss POM material having the following dielectric parameters: relative permittivity ε = 3 and loss tangent δ = 0.02.

4.2 Body-Worn Accessory Configurations

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 6.4). Per FCC KDB Publication 648474 D04v01r03, Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB Publication 447498 D01v06 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

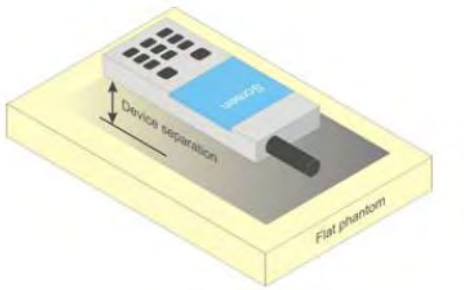

Figure 6.4 Sample Body-Worn Diagram

Accessories for Body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that do contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest spacing to the body. Then multiple accessories that contain metallic components are tested with the device with each accessory. If multiple accessories share an identical metallic component (i.e. the same metallic belt-clip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

Body-worn accessories may not always be supplied or available as options for some devices intended to be authorized for body-worn use. In this case, a test configuration with a separation distance between the back of the device and the flat phantom is used. Test position spacing was documented.

Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance with the front of the device positioned to face the flat phantom in head fluid. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessories, including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.

5. RF EXPOSURE LIMITS

Uncontrolled Environment:

UNCONTROLLED ENVIRONMENTS are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

Controlled Environment:

CONTROLLED ENVIRONMENTS are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Table 5.1.SAR Human Exposure Specified in ANSI/IEEE C95.1-1992

	HUMAN EXPOSURE LIMITS	
	General Public Exposure (W/kg) or (mW/g)	Occupational Exposure (W/kg) or (mW/g)
SPATIAL PEAK SAR * (Brain)	1.60	8.00
SPATIAL AVERAGE SAR ** (Whole Body)	0.08	0.40
SPATIAL PEAK SAR *** (Hands / Feet / Ankle / Wrist)	4.00	20.0

1. The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
2. The Spatial Average value of the SAR averaged over the whole body.
3. The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e.as a result of employment or occupation).

6. FCC MEASUREMENT PROCEDURES

6.1 SAR Testing with 802.11 Transmitters

The normal network operating configurations are not suitable for measuring the SAR of 802.11 b/g/n transmitters. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure the results are consistent and reliable. See KDB Publication 248227D01v02r02 for more details.

6.1.1 General Device Setup

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters. The test frequencies should correspond to actual channel frequencies defined for domestic use. SAR for devices with switched diversity should be measured with only one antenna transmitting at a time during each SAR measurement, according to a fixed modulation and data rate. The same data pattern should be used for all measurements.

A periodic duty factor is required for current generation SAR systems to measure SAR. When 802.11 frame gaps are accounted for in the in the transmission, a maximum transmission duty factor of 92-96 % is typically achievable in most test mode configurations. A minimum transmission duty factor of 85 % is required to avoid certain hardware and device implementation issues related to wide range SAR scaling. The reported SAR is scaled to 100 % transmission duty factor to determine compliance at the maximum tune-up tolerance limit.

6.1.2 U-NII and U-NII-2A

For devices that operate in only one of the U-NII-1 and U-NII-2A bands, the normally required SAR procedures for OFDM configurations are applied. For devices that operate in both U-NII bands using the same transmitter and antenna(s), SAR test reduction is determined according to the following, with respect to the highest reported SAR and maximum output power specified for production units. The procedures are applied independently to each exposure configuration; for example, head, body, hotspot mode etc.

1) When the same maximum output power is specified for both bands, begin SAR measurement in U-NII-2A band by applying the OFDM SAR requirements. If the highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band for that configuration (802.11 mode and exposure condition); otherwise, each band is tested independently for SAR.
2) When different maximum output power is specified for the bands, begin SAR measurement in the band with higher specified maximum output power. The highest reported SAR for the tested configuration is adjusted by the ratio of lower to higher specified maximum output power for the two bands. When the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for the band with lower maximum output power in that test configuration; otherwise, each band is tested independently for SAR.

6.1.3 U-NII-2C and U-NII-3

The frequency range covered by U-NII-2C and U-NII-3 is 380 MHz (5.47 – 5.85 GHz), which requires a minimum of at least two SAR probe calibration frequency points to support SAR measurements.

When Terminal Doppler Weather Rader (TDWR) restriction applies, the channels at 5.60 – 5.65 GHz in U-NII-2C band must be disabled with acceptable mechanisms and documented in the equipment certification.

Unless band gap channels are permanently disabled, SAR must be considered for these channels. When band gap channels are disabled, each band is tested independently according to the normally required OFDM SAR measurements and probe calibration frequency points requirements.

6.1.4 Initial Test Position Procedure

For exposure conditions with multiple test positions, such as handset operating next to the ear, devices with hotspot mode or UMPC mini-tablet, procedures for initial test position can be applied. Using the transmission mode determined by the DSSS procedure or initial test configuration, area scans are measured for all position in an exposure condition. The test position with the highest extrapolated (peak) SAR is used as the initial test position. When reported SAR for the initial test position is ≤ 0.4 W/kg, no additional testing for the remaining test positions is required. Otherwise, SAR is evaluated at the subsequent highest peak SAR position until the reported SAR result is ≤ 0.8 W/kg or all test position are measured.

6.1.5 2.4 GHz SAR Test Requirements

SAR is measured for 2.4 GHz 802.11b DSSS using either a fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:

1) When the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
2) When the reported SAR is > 0.8 W/kg, SAR is required for that exposure configuration using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.

2.4 GHz 802.11 g/n OFDM are additionally evaluated for SAR if the highest reported SAR for 802.11b, adjusted by the ratio of the OFDM to DSSS specified maximum output power is > 1.2 W/kg. When SAR is required for OFDM modes in 2.4 GHz band, the Initial Test Configuration Procedures should be followed.

6.1.6 OFDM Transmission Mode and SAR Test Channel Selection

For the 2.4 GHz and 5 GHz bands, when the same maximum output power was specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration with the largest channel bandwidth, lowest order modulation and lowest data rate. When the maximum output power of a channel is the same for equivalent OFDM configurations; for example, 802.11a and 802.11n or 802.11g and 802.11n with the same channel bandwidth, modulation and data rate etc., the lower order 802.11 mode i.e., 802.11a, then 80211n or 802.11g then 802.11n is used for SAR measurement. When the maximum output power ware the same for multiple test channels, either according to the default or additional power measurement requirements, SAR is measured using the channel closest to the middle of the frequency band or aggregated band. When there are multiple channels with the same maximum output power, SAR is measured using the higher number channel.

6.1.7 Initial Test Configuration Procedure

For OFDM, in both 2.4 GHz and 5 GHz bands, an initial test configuration is determined for each frequency band and aggregated band, according to the transmission mode with the highest maximum output power specified for SAR measurements. When the same maximum output is specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration(s) with the largest channel bandwidth, lowest order modulation, and lowest data rate. The channel of the transmission mode with the highest average RF output conducted power will be the initial test configuration.

When the reported SAR is ≤ 0.8 W/kg, no additional measurements on other test channels are required.
Otherwise, SAR is evaluated using the subsequent highest average RF output channel until the reported SAR result is ≤ 1.2 W/kg or all channels are measured.

6.1.8 Subsequent Test Configuration Procedures

For OFDM configurations, in each frequency band and aggregated band, SAR is evaluated for initial test configuration using the fixed test position or the initial test position procedure, when applicable. When the highest reported SAR for the initial test configuration, adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power is ≤ 1.2 W/kg, no additional SAR testing for the subsequent test configurations is required.

6.1.9 MIMO SAR considerations

Per KDB Publication 248227 D01v02r02, the simultaneous SAR provision in KDB Publication 447498 D01v06 should be applied to determine simultaneous transmission SAR test exclusion for WIFI MIMO. If the sum of 1 g single transmission chain SAR measurements is < 1.6 W/kg, no additional SAR measurements for MIMO are required. Alternatively, SAR for MIMO can be measured with all antennas transmitting simultaneously at the specified maximum output power of MIMO operation.

7. RF CONDUCTED POWERS

This device operates using the following maximum and nominal output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 447498 D01v06.

7.1 WLAN Nominal and Maximum Output Power Spec and Conducted Powers

Band (GHz)	Mode	Ch	Modulated Average[dBm]					
			Ant.1 (Aux)		Ant.2 (Main)		MIMO	
			Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
2.4	802.11b	1-6	14.99	13.99	14.99	13.99	18.00	17.00
		11-13	15.99	14.99	15.99	14.99	19.00	18.00
	802.11g (6 Mbps)	1-11	14.99	13.99	14.99	13.99	18.00	17.00
		12	15.99	14.99	15.99	14.99	19.00	18.00
		13	13.99	12.99	13.99	12.99	17.00	16.00
	802.11n (HT20, MCS0)	1	14.99	13.99	14.99	13.99	18.00	17.00
		6-13	15.99	14.99	15.99	14.99	19.00	18.00
	802.11n (HT40, MCS0)	3	12.99	11.99	12.99	11.99	16.00	15.00
		6	18.49	17.49	18.49	17.49	21.50	20.50
		9	15.99	14.99	15.99	14.99	19.00	18.00

Table 7.1.1 Nominal and Maximum Output Power Spec

Mode	Freq. (MHz)	Channel	IEEE 802.11 (2.4 GHz) Conducted Power[dBm]		
			Ant.1 (Aux)	Ant.2 (Main)	MIMO
802.11b	2 412	1	13.54	14.29	16.94
	2 437	6	14.79	14.66	17.74
	2 462	11	15.31	15.78	18.56
	2 467	12	14.58	14.33	17.47
	2 472	13	14.79	15.30	18.06
802.11g (6 Mbps)	2 412	1	13.92	13.87	16.91
	2 437	6	13.61	13.95	16.79
	2 462	11	14.29	14.49	17.40
	2 467	12	14.21	14.39	17.31
	2 472	13	13.25	13.43	16.35
802.11n (HT-20) (MCS0)	2 412	1	13.68	14.60	17.17
	2 437	6	15.06	15.23	18.16
	2 462	11	15.18	15.79	18.51
	2 467	12	14.22	14.35	17.30
	2 472	13	14.01	14.47	17.26
802.11n (HT-40) (MCS0)	2 422	3	12.95	12.71	15.84
	2 437	6	17.55	17.44	20.51
	2 452	9	14.81	15.09	17.96

Table 7.1.2 IEEE 802.11 Average RF Power

Band (GHz)	Mode	Ch	Modulated Average[dBm]					
			Ant.1 (Aux)		Ant.2 (Main)		MIMO	
			Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
5 (U-NII-1)	802.11a (6 Mbps)	36	10.99	9.99	10.99	9.99	14.00	13.00
		40	10.99	9.99	10.99	9.99	14.00	13.00
		44	10.99	9.99	10.99	9.99	14.00	13.00
		48	7.99	6.99	7.99	6.99	11.00	10.00
5 (U-NII-2A)	802.11a (6 Mbps)	52	7.99	6.99	7.99	6.99	11.00	10.00
		56	8.99	7.99	8.99	7.99	12.00	11.00
		60	8.99	7.99	8.99	7.99	12.00	11.00
		64	10.99	9.99	10.99	9.99	14.00	13.00
5 (U-NII-2C)	802.11a (6 Mbps)	100	12.99	11.99	12.99	11.99	16.00	15.00
		116	14.99	13.99	14.99	13.99	18.00	17.00
		132	14.99	13.99	14.99	13.99	18.00	17.00
		144	14.99	13.99	14.99	13.99	18.00	18.00
5 (U-NII-3)	802.11a (6 Mbps)	149	15.99	14.99	15.99	14.99	19.00	18.00
		157	15.99	14.99	15.99	14.99	19.00	18.00
		165	13.99	12.99	13.99	12.99	17.00	16.00

Table 7.1.3 Nominal and Maximum Output Power Spec

Mode	Freq. (MHz)	Channel	IEEE 802.11a (5 GHz) Conducted Power[dBm]		
			Ant.1(Aux)	Ant.2 (Main)	MIMO
802.11a (6 Mbps)	5 180	36	9.81	9.34	12.59
	5 200	40	9.76	9.22	12.51
	5 220	44	9.55	9.15	12.36
	5 240	48	7.89	7.34	10.63
	5 260	52	7.69	7.64	10.68
	5 280	56	7.73	7.81	10.78
	5 300	60	8.86	8.61	11.75
	5 320	64	9.37	9.12	12.26
	5 500	100	11.72	11.43	14.59
	5 580	116	14.10	13.18	16.67
	5 660	132	14.12	13.77	16.96
	5 720	144	14.51	14.13	17.33
	5 745	149	14.31	14.04	17.19
	5 785	157	14.61	14.02	17.34
	5 825	165	13.01	12.27	15.67

Table 7.1.4 IEEE 802.11a Average RF Power

Band (GHz)	Mode	Ch	Modulated Average[dBm]					
			Ant.1 (Aux)		Ant.2 (Main)		MIMO	
			Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
5 (U-NII-1)	802.11n (20MHz) (MCS0)	36	10.99	9.99	10.99	9.99	14.00	13.00
		40	10.99	9.99	10.99	9.99	14.00	13.00
		44	10.99	9.99	10.99	9.99	14.00	13.00
		48	9.99	8.99	9.99	8.99	13.00	12.00
5 (U-NII-2A)	802.11n (20MHz) (MCS0)	52	8.99	7.99	8.99	7.99	12.00	11.00
		56	9.99	8.99	9.99	8.99	13.00	12.00
		60	9.99	8.99	9.99	8.99	13.00	12.00
		64	11.99	10.99	11.99	10.99	15.00	14.00
5 (U-NII-2C)	802.11n (20MHz) (MCS0)	100	13.99	12.99	13.99	12.99	17.00	16.00
		116	14.99	13.99	14.99	13.99	18.00	17.00
		132	14.99	13.99	14.99	13.99	18.00	17.00
		144	15.99	14.99	15.99	14.99	19.00	18.00
5 (U-NII-3)	802.11n (20MHz) (MCS0)	149	15.99	14.99	15.99	14.99	19.00	18.00
		157	15.99	14.99	15.99	14.99	19.00	18.00
		165	14.99	13.99	14.99	13.99	18.00	17.00

Table 7.1.5 Nominal and Maximum Output Power Spec

Mode	Freq. (MHz)	Channel	IEEE 802.11n HT20 (5 GHz) Conducted Power[dBm]		
			Ant.1 (Aux)	Ant.2 (Main)	MIMO
802.11n (HT-20) (MCS0)	5 180	36	10.08	10.06	13.08
	5 200	40	10.06	10.02	13.05
	5 220	44	10.01	10.05	13.04
	5 240	48	9.45	9.66	12.57
	5 260	52	8.79	8.64	11.73
	5 280	56	8.88	8.73	11.82
	5 300	60	9.67	9.30	12.50
	5 320	64	11.14	11.29	14.23
	5 500	100	13.13	12.56	15.86
	5 580	116	14.04	13.87	16.97
	5 660	132	14.22	14.05	17.15
	5 720	144	14.24	14.09	17.18
	5 745	149	14.48	14.11	17.31
	5 785	157	14.34	14.05	17.21
	5 825	165	14.22	13.94	17.09

Table 7.1.6 IEEE 802.11n HT20 Average RF Power

Band (GHz)	Mode	Ch	Modulated Average[dBm]					
			Ant.1 (Aux)		Ant.2 (Main)		MIMO	
			Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
5 (U-NII-1)	802.11ac (20MHz) (MCS0)	36	10.99	9.99	10.99	9.99	14.00	13.00
		40	10.99	9.99	10.99	9.99	14.00	13.00
		44	10.99	9.99	10.99	9.99	14.00	13.00
		48	9.99	8.99	9.99	8.99	13.00	12.00
5 (U-NII-2A)	802.11ac (20MHz) (MCS0)	52	9.99	8.99	9.99	8.99	13.00	12.00
		56	12.99	11.99	12.99	11.99	16.00	15.00
		60	12.99	11.99	12.99	11.99	16.00	15.00
		64	12.99	11.99	12.99	11.99	16.00	15.00
5 (U-NII-2C)	802.11ac (20MHz) (MCS0)	100	13.99	12.99	13.99	12.99	17.00	16.00
		116	13.99	12.99	13.99	12.99	17.00	16.00
		132	13.99	12.99	13.99	12.99	17.00	16.00
		144	15.99	14.99	15.99	14.99	19.00	18.00
5 (U-NII-3)	802.11ac (20MHz) (MCS0)	149	15.99	14.99	15.99	14.99	19.00	18.00
		157	15.99	14.99	15.99	14.99	19.00	18.00
		165	15.99	14.99	15.99	14.99	19.00	18.00

Table 7.1.7 Nominal and Maximum Output Power Spec

Mode	Freq. (MHz)	Channel	IEEE 802.11ac VHT20 (5 GHz) Conducted Power[dBm]		
			Ant.1 (Aux)	Ant.2 (Main)	MIMO
802.11ac (VHT-20) (MCS0)	5 180	36	10.40	10.16	13.29
	5 200	40	10.11	10.07	13.10
	5 220	44	10.15	10.15	13.16
	5 240	48	9.55	9.45	12.51
	5 260	52	9.60	9.20	12.41
	5 280	56	11.59	12.11	14.87
	5 300	60	11.84	12.17	15.02
	5 320	64	12.23	12.47	15.36
	5 500	100	13.45	13.22	16.35
	5 580	116	13.45	13.39	16.43
	5 660	132	13.58	13.45	16.53
	5 720	144	14.63	14.22	17.44
	5 745	149	14.44	14.27	17.37
	5 785	157	14.41	14.21	17.32
	5 825	165	14.14	14.08	17.12

Table 7.1.8 IEEE 802.11ac VHT20 Average RF Power

Band (GHz)	Mode	Ch	Modulated Average[dBm]					
			Ant.1 (Aux)		Ant.2 (Main)		MIMO	
			Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
5 (U-NII-1)	802.11n (40MHz) (MCS0)	38	9.99	8.99	9.99	8.99	13.00	12.00
		46	12.99	11.99	12.99	11.99	16.00	15.00
5 (U-NII-2A)	802.11n (40MHz) (MCS0)	54	11.99	10.99	11.99	10.99	15.00	14.00
		62	11.99	10.99	11.99	10.99	15.00	14.00
5 (U-NII-2C)	802.11n (40MHz) (MCS0)	102	10.99	9.99	10.99	9.99	14.00	13.00
		110	14.99	13.99	14.99	13.99	18.00	17.00
		134	14.99	13.99	14.99	13.99	18.00	17.00
		142	15.99	14.99	15.99	14.99	19.00	18.00
5 (U-NII-3)	802.11n (40MHz) (MCS0)	151	15.99	14.99	15.99	14.99	19.00	18.00
		159	15.99	14.99	15.99	14.99	19.00	18.00

Table 7.1.9 Nominal and Maximum Output Power Spec

Mode	Freq. (MHz)	Channel	IEEE 802.11n HT40 (5 GHz) Conducted Power[dBm]		
			Ant.1 (Aux)	Ant.2 (Main)	MIMO
802.11n (HT-40) (MCS0)	5 190	38	9.91	9.87	12.90
	5 230	46	12.87	12.48	15.69
	5 270	54	11.92	11.27	14.62
	5 310	62	11.25	10.08	13.71
	5 510	102	10.88	10.43	13.67
	5 590	118	13.86	13.29	16.59
	5 670	134	14.02	13.88	16.96
	5 710	142	14.11	14.01	17.07
	5 755	151	14.26	14.04	17.16
	5 795	159	14.35	14.05	17.21

Table 7.1.10 IEEE 802.11n HT40 Average RF Power

Band (GHz)	Mode	Ch	Modulated Average[dBm]					
			Ant.1 (Aux)		Ant.2 (Main)		MIMO	
			Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
5 (U-NII-1)	802.11ac (40MHz) (MCS0)	38	8.99	7.99	8.99	7.99	12.00	11.00
		46	12.99	11.99	12.99	11.99	16.00	15.00
5 (U-NII-2A)	802.11ac (40MHz) (MCS0)	54	13.99	12.99	13.99	12.99	17.00	16.00
		62	10.99	9.99	10.99	9.99	14.00	13.00
5 (U-NII-2C)	802.11ac (40MHz) (MCS0)	102	10.99	9.99	10.99	9.99	14.00	13.00
		110	13.99	12.99	13.99	12.99	17.00	16.00
		134	13.99	12.99	13.99	12.99	17.00	16.00
		142	15.99	14.99	15.99	14.99	19.00	18.00
5 (U-NII-3)	802.11ac (40MHz) (MCS0)	151	15.99	14.99	15.99	14.99	19.00	18.00
		159	15.99	14.99	15.99	14.99	19.00	18.00

Table 7.1.11 Nominal and Maximum Output Power Spec

Mode	Freq. (MHz)	Channel	IEEE 802.11ac VHT40 (5 GHz) Conducted Power[dBm]		
			Ant.1 (Aux)	Ant.2 (Main)	MIMO
802.11ac (VHT-40) (MCS0)	5 190	38	8.95	8.60	11.79
	5 230	46	12.56	12.31	15.45
	5 270	54	13.48	13.37	16.44
	5 310	62	10.87	10.47	13.68
	5 510	102	10.02	9.02	12.56
	5 590	118	12.69	12.02	15.38
	5 670	134	13.11	12.88	16.01
	5 710	142	14.67	14.00	17.36
	5 755	151	14.61	14.11	17.38
	5 795	159	14.42	14.02	17.23

Table 7.1.12 IEEE 802.11ac VHT40 Average RF Power

Band (GHz)	Mode	Ch	Modulated Average[dBm]					
			Ant.1 (Aux)		Ant.2 (Main)		MIMO	
			Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
5 (U-NII-1)	802.11ac (80MHz) (MCS0)	42	9.99	8.99	9.99	8.99	13.00	12.00
5 (U-NII-2A)	802.11ac (80MHz) (MCS0)	58	10.99	9.99	10.99	9.99	14.00	13.00
5 (U-NII-2C)	802.11ac (80MHz) (MCS0)	106	11.99	10.99	11.99	10.99	15.00	14.00
		138	13.99	12.99	13.99	12.99	17.00	16.00
5 (U-NII-3)	**802.11ac (80MHz) (MCS0)**	**155**	**15.99**	**14.99**	**15.99**	**14.99**	**19.00**	**18.00**

Table 7.1.13 Nominal and Maximum Output Power Spec

Mode	Freq. (MHz)	Channel	IEEE 802.11ac VHT80 (5 GHz) Conducted Power[dBm]		
			Ant.1 (Aux)	Ant.2 (Main)	MIMO
802.11ac (VHT-80) (MCS0)	5 210	42	9.93	9.53	12.74
	5 290	58	10.89	10.33	13.63
	5 530	106	11.47	10.16	13.87
	5 690	138	12.59	12.25	15.43
	5 775	**155**	**14.34**	**14.55**	**17.46**

Table 7.7.14 IEEE 802.11ac VHT80 Average RF Power

Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v02r02:

- Power measurements were performed for the transmission mode configuration with the highest maximum output power specified for production units.
- For transmission modes with the same maximum output power specification, powers were measured for the largest channel bandwidth, lowest order modulation and lowest data rate.
- For transmission modes with identical maximum specified output power, channel bandwidth, modulation and data rates, power measurements were required for all identical configurations.
- For each transmission mode configuration, powers were measured for the highest and lowest channels; and at the mid-band channel(s) when there were at least 3 channels supported. For configurations with multiple mid-band channels, duo to an even number of channels, both channels were measured.
- The underlined data rate and channel above were tested for SAR.

The average output powers of this device were tested by below configuration.

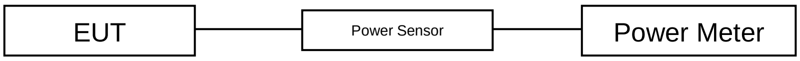

Figure 7.1.1 Power Measurement Setup

8. SYSTEM VERIFICATION

8.1 Tissue Verification

MEASURED TISSUE PARAMETERS										
Date(s)	Tissue Type	Ambient Temp.[°C]	Liquid Temp.[°C]	Measured Frequency [MHz]	Target Dielectric Constant, εr	Target Conductivity, σ (S/m)	Measured Dielectric Constant, εr	Measured Conductivity, σ (S/m)	Er Deviation [%]	σ Deviation [%]
Sep. 06. 2022	2 450 Head	20.7	20.9	2 422.0	39.248	1.775	39.904	1.785	1.67	0.56
				2 437.0	39.222	1.788	39.856	1.803	1.62	0.84
				2 450.0	39.200	1.800	39.817	1.817	1.57	0.94
				2 452.0	39.197	1.802	39.812	1.819	1.57	0.94
Aug. 31. 2022	5 200 Head	20.9	20.8	5 190.0	36.010	4.650	34.996	4.513	-2.82	-2.95
				5 200.0	36.000	4.660	34.972	4.526	-2.86	-2.88
				5 230.0	35.970	4.690	34.914	4.558	-2.94	-2.81
Aug. 31. 2022	5 300 Head	20.9	20.8	5 270.0	35.930	4.730	34.831	4.605	-3.06	-2.64
				5 300.0	35.900	4.760	34.766	4.636	-3.16	-2.61
				5 310.0	35.890	4.770	34.741	4.650	-3.20	-2.52
Sep. 01. 2022	5 600 Head	20.8	20.7	5 500.0	35.650	4.965	36.350	4.899	1.96	-1.33
				5 510.0	35.635	4.976	36.331	4.908	1.95	-1.37
				5 550.0	35.575	5.018	36.260	4.953	1.93	-1.30
				5 600.0	35.500	5.070	36.169	5.013	1.88	-1.12
				5 670.0	35.430	5.140	36.046	5.090	1.74	-0.97
				5 710.0	35.390	5.180	35.982	5.141	1.67	-0.75
				5 800.0	35.300	5.270	35.816	5.245	1.46	-0.47
Sep. 01. 2022	5 800 Head	20.8	20.7	5 775.0	35.325	5.245	35.864	5.211	1.53	-0.65
				5 800.0	35.300	5.270	35.816	5.245	1.46	-0.47

The above measured tissue parameters were used in the DASY software. The DASY software was used to perform interpolation to determine the dielectric parameters at the SAR test device frequencies (per KDB 865664 and IEEE 1528-2013 6.6.1.2). The tissue parameters listed in the SAR test plots may slightly differ from the table above due to significant digit rounding in the software.

Measurement Procedure for Tissue verification:

1) The network analyzer and probe system was configured and calibrated.
2) The probe was immersed in the sample which was placed in a nonmetallic container. Trapped air bubbles beneath the flange were minimized by placing the probe at a slight angle.
3) The complex admittance with respect to the probe aperture was measured
4) The complex relative permittivity , for example from the below equation (Pournaropoulos and Misra):

$$Y = \frac{j2\omega\varepsilon_r\varepsilon_0}{[\ln(b/a)]^2}\int_a^b\int_a^b\int_0^\pi \cos\phi' \frac{\exp[-j\omega r(\mu_0\varepsilon_r\varepsilon_0)^{1/2}]}{r} d\phi' d\rho' d\rho$$

where Y is the admittance of the probe in contact with the sample, the primed and unprimed coordinates refer to source and observation points, respectively, $r^2 = \rho^2 + \rho'^2 - 2\rho\rho'\cos\phi'$, ω is the angular frequency, and $j = \sqrt{-1}$.

8.2 Test System Verification

Prior to assessment, the system is verified to the ±10 % of the specifications at using the SAR Dipole kit(s). (Graphic Plots Attached)

Table 9.2.1 System Verification Results (1 g)

SYSTEM DIPOLE VERIFICATION TARGET & MEASURED												
SAR System #	Freq. [MHz]	SAR Dipole kits	Date(s)	Tissue Type	Ambient Temp. [°C]	Liquid Temp. [°C]	Probe S/N	Input Power (mW)	1 W Target SAR_{1g} (W/kg)	Measured SAR_{1g} (W/kg)	1 W Normalized SAR_{1g} (W/kg)	Deviation [%]
C	2 450	D2450V2, SN: 726	Sep. 6. 2022	Head	20.7	20.9	3866	100	51.80	5.26	52.60	1.54
E	5 200	D5GHzV2, SN:1212	Aug. 31. 2022	Head	20.9	20.8	7368	100	81.00	7.86	78.60	-2.96
E	5 300	D5GHzV2, SN:1212	Aug. 31. 2022	Head	20.9	20.8	7368	100	82.00	8.26	82.60	0.73
E	5 500	D5GHzV2, SN:1212	Sep. 1. 2022	Head	20.8	20.7	7368	100	85.50	8.40	84.00	-1.75
E	5 600	D5GHzV2, SN:1212	Sep. 1. 2022	Head	20.8	20.7	7368	100	84.10	8.63	86.30	2.62
E	5 800	D5GHzV2, SN:1212	Sep. 1. 2022	Head	20.8	20.7	7368	100	82.00	8.13	81.30	-0.85

Note(s)
1. System Verification was measured with input 100 mW and normalized to 1 W.
2. Full system validation status and results can be found in Appendix D.

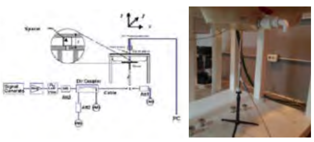

Figure 8.1 Dipole Verification Test Setup Diagram & Photo

9. SAR TEST RESULTS

9.1 Standalone Body SAR Results

Table 9.1.1 DTS Body SAR

MEASUREMENT RESULTS

FREQUENCY MHz	FREQUENCY Ch	Mode	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Peak SAR of Area Scan	Data Rate [Mbps]	Duty Cycle (%)	1 g SAR (W/kg)	Scaling Factor	Scaling Factor (Duty Cycle)	SAR (W/kg)	Plots #
2 437.0	6	802.11n (HT40) Ant.1	18.49	17.55	0.000	0 mm [Front]	FCC #1	0.023	MCS0	94.2	0.021	1.242	1.062	**0.028**	A1
2 437.0	6	802.11n (HT40) Ant.2	18.49	17.44	0.100	0 mm [Front]	FCC #1	0.013	MCS0	94.2	0.008	1.274	1.062	**0.011**	A2
2 437.0	6	802.11n (HT40) MIMO	21.50	20.51	0.000	0 mm [Front]	FCC #1	0.021	MCS0	95.3	0.019	1.256	1.049	**0.025**	A3
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								Body 1.6 W/kg (mW/g) averaged over 1 gram							

Adjusted SAR results for OFDM SAR

FREQUENCY MHz	FREQUENCY Ch	Mode/ Antenna	Service	Maximum Allowed Power [dBm]	1 g Scaled SAR (W/kg)	FREQUENCY [MHz]	Mode	Service	Maximum Allowed Power [dBm]	Ratio	1 g Adjusted SAR (W/kg)	Determine SAR
2 437.0	6	802.11n (HT40) Ant.1	OFDM	18.49	0.028	2 462.0	802.11b	DSSS	15.99	0.562	**0.016**	X
2 437.0	6	802.11n (HT40) Ant.1	OFDM	18.49	0.028	2 462.0	802.11g	OFDM	14.99	0.447	**0.013**	X
2 437.0	6	802.11n (HT40) Ant.1	OFDM	18.49	0.028	2 462.0	802.11n (HT20)	OFDM	15.99	0.562	**0.016**	X
2 437.0	6	802.11n (HT40) Ant.2	OFDM	18.49	0.011	2 462.0	802.11b	DSSS	15.99	0.562	**0.006**	X
2 437.0	6	802.11n (HT40) Ant.2	OFDM	18.49	0.011	2 462.0	802.11g	OFDM	14.99	0.447	**0.005**	X
2 437.0	6	802.11n (HT40) Ant.2	OFDM	18.49	0.011	2 462.0	802.11n (HT20)	OFDM	15.99	0.562	**0.006**	X
2 437.0	6	802.11n (HT40) MIMO	OFDM	21.50	0.025	2 462.0	802.11b	DSSS	19.00	0.562	**0.014**	X
2 437.0	6	802.11n (HT40) MIMO	OFDM	21.50	0.025	2 462.0	802.11g	OFDM	18.00	0.447	**0.011**	X
2 437.0	6	802.11n (HT40) MIMO	OFDM	21.50	0.025	2 462.0	802.11n (HT20)	OFDM	19.00	0.562	**0.014**	X
ANSI / IEEE C95.1-1992– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure						Body 1.6 W/kg (mW/g) averaged over 1 gram						

Table 9.1.2 UNII Body SAR

MEASUREMENT RESULTS

FREQUENCY MHz	FREQUENCY Ch	Mode	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Peak SAR of Area Scan	Data Rate [Mbps]	Duty Cycle (%)	1 g SAR (W/kg)	Scaling Factor	Scaling Factor (Duty Cycle)	1 g Scaled SAR (W/kg)	Plots #
5 230.0	46	802.11n (HT40) Ant.1	12.99	12.87	-0.070	0 mm [Front]	FCC #1	0.022	MCS0	95.3	0.023	1.028	1.049	**0.025**	A4
5 230.0	46	802.11n (HT40) Ant.2	12.99	12.48	0.000	0 mm [Front]	FCC #1	0.024	MCS0	95.3	0.016	1.125	1.049	**0.019**	A5
5 230.0	46	802.11n (HT40) MIMO	16.00	15.69	0.060	0 mm [Front]	FCC #1	0.027	MCS0	95.3	0.022	1.074	1.049	**0.025**	A6
5 270.0	54	802.11ac (VHT40) Ant.1	13.99	13.48	-0.090	0 mm [Front]	FCC #1	0.038	MCS0	94.3	0.025	1.125	1.060	**0.030**	A7
5 270.0	54	802.11ac (VHT40) Ant.2	13.99	13.37	-0.040	0 mm [Front]	FCC #1	0.037	MCS0	94.3	0.021	1.153	1.060	**0.026**	A8
5 270.0	54	802.11ac (VHT40) MIMO	17.00	16.44	-0.170	0 mm [Front]	FCC #1	0.042	MCS0	94.2	0.027	1.138	1.062	**0.033**	A9
ANSI / IEEE C95.1-2005– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								Body 1.6 W/kg (mW/g) averaged over 1 gram							

Table 9.1.3 UNII Body SAR

MEASUREMENT RESULTS

FREQUENCY MHz	FREQUENCY Ch	Mode	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Drift Power [dB]	Phantom Position	Device Serial Number	Peak SAR of Area Scan	Data Rate [Mbps]	Duty Cycle (%)	1 g SAR (W/kg)	Scaling Factor	Scaling Factor (Duty Cycle)	1 g Scaled SAR (W/kg)	Plots #
5 710.0	142	802.11n (HT40) Ant.1	15.99	14.11	0.160	0 mm [Front]	FCC #1	0.004	MCS0	94.3	0.005	1.542	1.060	**0.008**	A10
5 710.0	142	802.11n (HT40) Ant.2	15.99	14.01	0.140	0 mm [Front]	FCC #1	0.024	MCS0	94.3	0.024	1.578	1.060	**0.040**	A11
5 710.0	142	802.11n (HT40) MIMO	19.00	17.07	0.030	0 mm [Front]	FCC #1	0.025	MCS0	94.2	0.016	1.560	1.062	**0.027**	A12
5 775.0	155	802.11ac (VHT80) Ant.1	15.99	14.34	0.000	0 mm [Front]	FCC #1	< 0.001	MCS0	88.9	0.005	1.462	1.125	**0.008**	A13
5 775.0	155	802.11ac (VHT80) Ant.2	15.99	14.55	0.060	0 mm [Front]	FCC #1	0.020	MCS0	88.9	0.009	1.393	1.125	**0.014**	A14
5 775.0	155	802.11ac (VHT80) MIMO	19.00	17.46	0.140	0 mm [Front]	FCC #1	0.022	MCS0	88.9	0.015	1.426	1.125	**0.024**	A15
ANSI / IEEE C95.1-2005– SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population Exposure								Body 1.6 W/kg (mW/g) averaged over 1 gram							

9.2 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2013, and FCC KDB Publication 447498 D01v06.
2. Batteries are fully charged at the beginning of the SAR measurements. A standard battery was used for all SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v06.

WLAN Notes:

1. The initial test position procedures were applied. The test position with the highest extrapolated peak SAR will be used as the initial test position. When reported SAR for the initial test position is ≤ 0.4 W/kg, no additional testing for the remaining test positions was required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is ≤ 0.8 W/kg or all test positions are measured.
2. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 2.4 GHz WIFI single transmission chain operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4 GHz 802.11g/n) was not required duo to the maximum allowed powers and the highest reported DSSS SAR when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output and the adjust SAR is ≤ 1.2 W/kg.
3. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 5 GHz WIFI single transmission chain operations, the initial test configuration was selected according to the transmission mode with the highest maximum allowed powers. Other transmission modes were not investigated since the highest reported SAR for initial test configuration adjusted by the ratio of maximum output powers is less than 1.2 W/kg.
4. When the maximum reported 1 g averaged SAR ≤ 0.8 W/kg, SAR testing on additional channels was not required. Otherwise, SAR for the next highest output power channel was required until the reported SAR result was ≤ 1.20 W/kg or all test channels were measured**.**
5. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor to determine compliance.
6. Per KDB Publication 248227 D01v02r02, SAR for MIMO was evaluated by following the simultaneous SAR provisions from KDB Publication 447498 D01v06 by making a SAR measurement with both antennas transmitting simultaneously.

10. SAR MEASUREMENT VARIABILITY

10.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01r04, SAR measurement variability was assessed for each frequency band, which was determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media were required for SAR measurements in a frequency band, the variability measurement procedures were applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. These additional measurements were repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device was returned to ambient conditions (normal room temperature) with the battery fully charged before it was re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR Measurement Variability was assessed using the following procedures for each frequency band:

1. When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once.
2. A second repeated measurement was performed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg (~ 10 % from the 1-g SAR limit).
3. A third repeated measurement was performed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.
4. Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg
5. The same procedures should be adapted for measurements according to extremity exposure limits by applying a factor of 2.5 for extremity exposure to the corresponding SAR thresholds.

10.2 Measurement Uncertainty

The measured SAR was < 1.5 W/kg for 1 g and < 3.75 W/kg for 10 g for all frequency bands. Therefore, per KDB Publication 865664 D01v01r04, the extended measurement uncertainty analysis per IEEE 1528-2013 was not required.

11. EQUIPMENT LIST

Table 11.1.1 Test Equipment Calibration

	Type	Manufacturer	Model	Cal.Date	Next.Cal.Date	S/N
☒	SEMITEC Engineering	SEMITEC	N/A	N/A	N/A	Shield Room
☒	SEMITEC Engineering	SEMITEC	N/A	N/A	N/A	Shield Room
☒	Robot	SPEAG	TX90XL	N/A	N/A	F13/5P9GA1/A/01
☒	Robot	SPEAG	TX60L	N/A	N/A	F15/50NHA1/A/01
☒	Robot Controller	SPEAG	CS8C	N/A	N/A	F13/5P9GA1/C/01
☒	Robot Controller	SPEAG	CS8C	N/A	N/A	F15/50NHA1/C/01
☒	Joystick	SPEAG	N/A	N/A	N/A	S-12450905
☒	Joystick	SPEAG	N/A	N/A	N/A	D21142605A
☒	Intel Core i7-3 770 3.40 GHz Windows 7 Professional	N/A	N/A	N/A	N/A	N/A
☒	Intel Core i7-8 700K 3.70 GHz Windows 10 Pro	N/A	N/A	N/A	N/A	N/A
☒	Probe Alignment Unit LB	N/A	N/A	N/A	N/A	SE UKS 030 AA
☒	Probe Alignment Unit LB	N/A	N/A	N/A	N/A	SE UKS 030 AA
☒	Device Holder	SPEAG	SD000H01KA	N/A	N/A	N/A
☒	Device Holder	SPEAG	SD000H01KA	N/A	N/A	N/A
☒	Laptop Holder	SPEAG	SMLH1001CD	N/A	N/A	N/A
☒	Laptop Holder	SPEAG	SMLH1001CD	N/A	N/A	N/A
☒	2mm Oval Phantom ELI5	SPEAG	QDOVA002AA	N/A	N/A	1237
☒	2mm Oval Phantom ELI6	SPEAG	QDOVA003AA	N/A	N/A	2039
☒	Data Acquisition Electronics	SPEAG	DAE3V1	2021-11-23	2022-11-23	520
☒	Data Acquisition Electronics	SPEAG	DAE4V1	2022-07-18	2023-07-18	1335
☒	Dosimetric E-Field Probe	SPEAG	EX3DV4	2022-04-29	2023-04-29	3866
☒	Dosimetric E-Field Probe	SPEAG	EX3DV4	2021-11-22	2022-11-22	7368
☒	2 450 MHz SAR Dipole	SPEAG	D2450V2	2021-09-22	2023-09-22	726
☒	5 GHz SAR Dipole	SPEAG	D5GHzV2	2022-01-31	2024-01-31	1212
☒	Network Analyzer	Agilent	E5071C	2022-06-24	2023-06-24	MY46106970
☒	Signal Generator	Agilent	E4438C	2022-06-24	2023-06-24	US41461520
☒	High Power RF Amplifier	EMPOWER	BBS3Q8CCJ	2022-06-24	2023-06-24	1005
☒	Power Meter	HP	EPM-442A	2021-12-16	2022-12-16	GB37170267
☒	Power Meter	Anritsu	ML2495A	2021-12-16	2022-12-16	1435003
☒	Power Sensor	Anritsu	MA2491A	2021-12-16	2022-12-16	0845478
☒	Power Sensor	HP	8481A	2021-12-16	2022-12-16	3318A96566
☒	Power Sensor	HP	8481A	2021-12-16	2022-12-16	2702A65976
☒	Dual Directional Coupler	HP	772D	2022-06-24	2023-06-24	2889A01064
☒	Low Pass Filter 3.0 GHz	Micro LAB	LA-30N	2022-06-24	2023-06-24	2
☒	Low Pass Filter 6.0 GHz	Micro LAB	LA-60N	2021-12-16	2022-12-16	03942
☒	Attenuators(10 dB)	WEINSCHEL	23-10-34	2021-12-16	2022-12-16	BP4387
☒	Attenuator	Saluki	3.5TS2-3dB-26.5G	2022-06-24	2023-06-24	21090703
☒	Dielectric Assessment kit	SPEAG	DAKS-3.5	2022-07-25	2023-07-25	1046
			R140	2022-07-26	2023-07-26	0101213

1. The E-field probe was calibrated by SPEAG, by temperature measurement procedure. Dipole Verification measurement is performed by Dt&C before each test. The brain and muscle simulating material are calibrated by Dt&C using the dielectric probe system and network analyzer to determine the conductivity and permittivity (dielectric constant) of the brain and muscle-equivalent material. Each equipment item was used solely within its respective calibration period.
2. CBT(Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. signal generator) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.

12. MEASUREMENT UNCERTAINTIES

750~2 600 MHz Head (SN: 3866)

Error Description	Uncertainty value (%)	Probability Distribution	Divisor	(Ci) 1 g	(Ci) 10 g	Standard 1 g (%)	Standard 10 g (%)	Ci x U_i 1 g	Ci x U_i 10 g	vi 2 or Veff
Measurement System										
Probe calibration	6.0	Normal	1	1	1	6.0	6.0	6.0	6.0	∞
Axial isotropy	4.7	Rectangular	√3	1	1	2.7	2.7	2.7	2.7	∞
Hemispherical isotropy	9.6	Rectangular	√3	1	1	5.5	5.5	5.5	5.5	∞
Boundary Effects	0.8	Rectangular	√3	1	1	0.46	0.46	0.46	0.46	∞
Probe Linearity	4.7	Rectangular	√3	1	1	2.7	2.7	2.7	2.7	∞
Probe modulation response	2.4	Rectangular	√3	1	1	1.4	1.4	1.4	1.4	∞
Detection limits	0.25	Rectangular	√3	1	1	0.14	0.14	0.14	0.14	∞
Readout Electronics	1.0	Normal	1	1	1	1.0	1.0	1.0	1.0	∞
Response time	0.8	Rectangular	√3	1	1	0.46	0.46	0.46	0.46	∞
Integration time	2.6	Rectangular	√3	1	1	1.5	1.5	1.5	1.5	∞
RF Ambient Conditions – Noise	3.0	Rectangular	√3	1	1	1.8	1.8	1.8	1.8	∞
RF Ambient Conditions – Reflections	3.0	Rectangular	√3	1	1	1.8	1.8	1.8	1.8	∞
Probe Positioner	0.4	Rectangular	√3	1	1	0.23	0.23	0.23	0.23	∞
Probe Positioning	2.9	Rectangular	√3	1	1	1.7	1.7	1.7	1.7	∞
Spatial x-y-Resolution	3.0	Rectangular	√3	1	1	5.8	5.8	5.8	5.8	∞
Fast SAR z-Approximation	3.0	Rectangular	√3	1	1	4.0	4.0	4.0	4.0	∞
Test Sample Related										
Device Positioning	2.9	Normal	1	1	1	2.9	2.9	2.9	2.9	145
Device Holder	3.6	Normal	1	1	1	3.6	3.6	3.6	3.6	5
Power Drift	5.0	Rectangular	√3	1	1	2.9	2.9	2.9	2.9	∞
SAR Scaling	2.0	Rectangular	√3	1	1	1.2	1.2	1.2	1.2	∞
Physical Parameters										
Phantom Shell	7.6	Rectangular	√3	1	1	4.4	4.4	4.4	4.4	∞
Liquid conductivity (Target)	5.0	Rectangular	√3	0.64	0.43	1.8	1.2	1.2	0.5	∞
Liquid conductivity (Meas.)	3.9	Normal	1	0.78	0.71	3.0	2.8	2.4	2.0	10
Liquid permittivity (Target)	5.0	Rectangular	√3	0.60	0.49	1.7	1.4	1.0	0.7	∞
Liquid permittivity (Meas.)	4.0	Normal	1	0.23	0.26	0.92	1.0	0.21	0.27	10
Temp. unc. - Conductivity	2.0	Rectangular	√3	0.78	0.71	0.90	0.82	0.70	0.58	∞
Temp. unc. - Permittivity	1.8	Rectangular	√3	0.23	0.26	0.24	0.27	0.05	0.07	∞
Combined Standard Uncertainty						**13**	**13**			330
Expanded Uncertainty (k=2)						**26**	**26**			

$U(1\ g) = k \times u_c$
= 2 x 13 %
= 26 % (The confidence level is about 95 % $k = 2$)
$U(10\ g) = k \times u_c$
= 2 x 13 %
= 26 % (The confidence level is about 95 % $k = 2$)

5 200 MHz ~ 5 800 MHz Head (SN: 7368)

Error Description	Uncertainty value ±%	Probability Distribution	Divisor	(Ci) 1 g	(Ci) 10 g	Standard 1 g (± %)	Standard 10 g (± %)	vi 2 or Veff
Measurement System								
Probe calibration	6.5	Normal	1	1	1	6.5	6.5	∞
Axial isotropy	4.7	Rectangular	√3	1	1	2.7	2.7	∞
Hemispherical isotropy	9.6	Rectangular	√3	1	1	5.5	5.5	∞
Boundary Effects	0.8	Rectangular	√3	1	1	0.46	0.46	∞
Probe Linearity	4.7	Rectangular	√3	1	1	2.7	2.7	∞
Probe modulation response	2.4	Rectangular	√3	1	1	1.4	1.4	∞
Detection limits	0.25	Rectangular	√3	1	1	0.14	0.14	∞
Readout Electronics	1.0	Normal	1	1	1	1.0	1.0	∞
Response time	0.8	Rectangular	√3	1	1	0.46	0.46	∞
Integration time	2.6	Rectangular	√3	1	1	1.5	1.5	∞
RF Ambient Conditions – Noise	3.0	Rectangular	√3	1	1	1.7	1.7	∞
RF Ambient Conditions – Reflections	3.0	Rectangular	√3	1	1	1.7	1.7	∞
Probe Positioner	0.4	Rectangular	√3	1	1	0.23	0.23	∞
Probe Positioning	2.9	Rectangular	√3	1	1	1.7	1.7	∞
Spatial x-y-Resolution	3.0	Rectangular	√3	1	1	5.8	5.8	∞
Fast SAR z-Approximation	3.0	Rectangular	√3	1	1	4.0	4.0	∞
Test Sample Related								
Device Positioning	2.9	Normal	1	1	1	2.9	2.9	145
Device Holder	3.6	Normal	1	1	1	3.6	3.6	5
Power Drift	5.0	Rectangular	√3	1	1	2.9	2.9	∞
SAR Scaling	2.0	Rectangular	√3	1	1	1.2	1.2	∞
Physical Parameters								
Phantom Shell	7.6	Rectangular	√3	1	1	4.4	4.4	∞
Liquid conductivity (Target)	5.0	Rectangular	√3	0.64	0.43	1.8	1.2	∞
Liquid conductivity (Meas.)	4.0	Normal	1	0.78	0.71	3.1	2.8	10
Liquid permittivity (Target)	5.0	Rectangular	√3	0.60	0.49	1.7	1.4	∞
Liquid permittivity (Meas.)	4.1	Normal	1	0.23	0.26	0.94	1.1	10
Temp. unc. - Conductivity	2.0	Rectangular	√3	0.78	0.71	0.90	0.82	∞
Temp. unc. - Permittivity	1.9	Rectangular	√3	0.23	0.26	0.25	0.29	∞
Combined Standard Uncertainty						**14**	**13**	330
Expanded Uncertainty (k=2)						**28**	**26**	

$U(1\ g) = k \cdot u_c$
$= 2 \cdot 14\ \%$
$= 28\ \%$ (The confidence level is about 95 % $k = 2$)
$U(10\ g) = k \cdot u_c$
$= 2 \cdot 13\ \%$
$= 26\ \%$ (The confidence level is about 95 % $k = 2$)

13. CONCLUSION

Measurement Conclusion

The SAR measurement indicates that the EUT complies with the RF radiation exposure limits of the FCC. These measurements are taken to simulate the RF effects exposure under the worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The tested device complies with the requirements in respect to all parameters subject to the test. The test results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body are every complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role impossible biological effect are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease).

Because innumerable factors may interact to determine the specific biological outcome of an exposure to electromagnetic fields, any protection guide shall consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.

14. REFERENCES

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[21] Industry Canada RSS-102 Radio Frequency Exposure Compliance of Radio communication Apparatus (All Frequency Bands) Issue 5, March 2015.

[22] Health Canada Safety Code 6 Limits of Human Exposure to Radio Frequency Electromagnetic Fields in the Frequency Range from 3 kHz – 300 GHz, 2009

[23] FCC SAR Test Procedures for 2G-3G Devices, Mobile Hotspot and UMPC Devices KDB Publications 941225,D01-D07

[24] SAR Measurement procedures for IEEE 802.11a/b/g KDB Publication 248227 D01v02

[25] FCC SAR Considerations for Handsets with Multiple Transmitters and Antennas, KDB Publications 648474D02-D04

[26] FCC SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers, FCC KDB Publication 616217 D04

[27] FCC SAR Measurement and Reporting Requirements for 100MHz – 6 GHz, KDB Publications 865664 D01-D02

[28] FCC General RF Exposure Guidance and SAR Procedures for Dongles, KDB Publication 447498, D01-D02

[29] 615223 D01 802 16e WI-Max SAR Guidance v01, Nov. 13, 2009

[30] Anexo à Resolução No. 533, de 10 de September de 2009.

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APPENDIX A. – Probe Calibration Data

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

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C Service suisse d'étalonnage
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Swiss Calibration Service

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The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **DT&C (Dymstec)**

Certificate No: **EX3-3866_Apr22**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3866
Calibration procedure(s)	QA CAL-01.v9, QA CAL-14.v6, QA CAL-23.v5, QA CAL-25.v7 Calibration procedure for dosimetric E-field probes
Calibration date:	April 29, 2022

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-22 (No. 217-03525/03524)	Apr-23
Power sensor NRP-Z91	SN: 103244	04-Apr-22 (No. 217-03524)	Apr-23
Power sensor NRP-Z91	SN: 103245	04-Apr-22 (No. 217-03525)	Apr-23
Reference 20 dB Attenuator	SN: CC2552 (20x)	04-Apr-22 (No. 217-03527)	Apr-23
DAE4	SN: 660	13-Oct-21 (No. DAE4-660_Oct21)	Oct-22
Reference Probe ES3DV2	SN: 3013	27-Dec-21 (No. ES3-3013_Dec21)	Dec-22
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-20)	In house check: Jun-22
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-22

	Name	Function	Signature
Calibrated by:	Jeffrey Katzman	Laboratory Technician	[signature]
Approved by:	Sven Kühn	Deputy Manager	[signature]

Issued: May 3, 2022

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Calibration Laboratory of
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Engineering AG
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Accreditation No.: **SCS 0108**

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3866

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.41	0.32	0.36	± 10.1 %
DCP (mV)[B]	103.2	104.8	104.3	

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Max dev.	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	168.8	±2.7 %	± 4.7 %
		Y	0.0	0.0	1.0		149.4		
		Z	0.0	0.0	1.0		152.9		

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

[A] The uncertainties of Norm X,Y,Z do not affect the E^2-field uncertainty inside TSL (see Page 5).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3866

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-118.6
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

Note: Measurement distance from surface can be increased to 3-4 mm for an *Area Scan* job.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3866

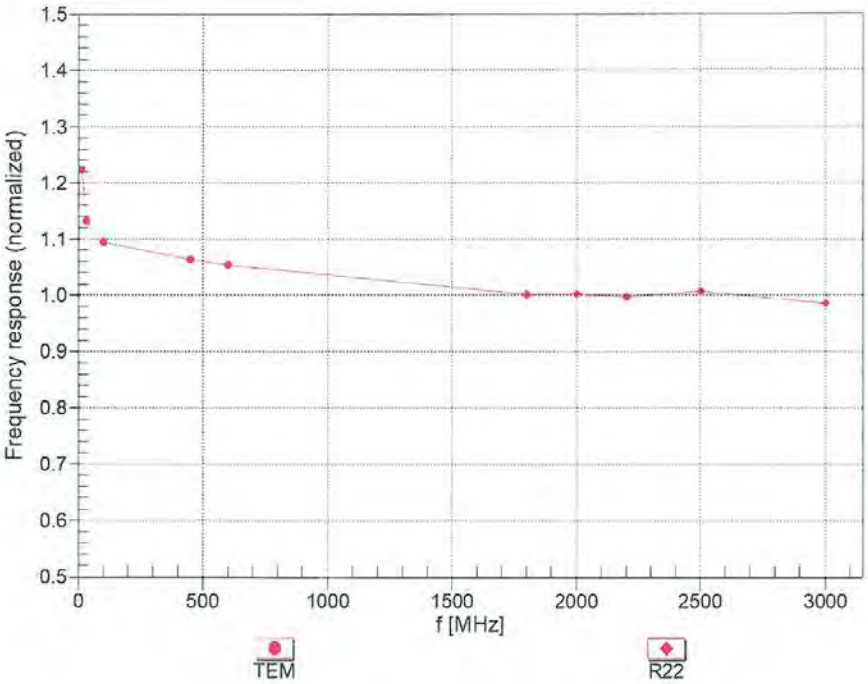
Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
750	41.9	0.89	9.74	9.74	9.74	0.41	0.80	± 12.0 %
835	41.5	0.90	9.36	9.36	9.36	0.42	0.86	± 12.0 %
900	41.5	0.97	9.20	9.20	9.20	0.41	0.86	± 12.0 %
1750	40.1	1.37	8.01	8.01	8.01	0.33	0.86	± 12.0 %
1900	40.0	1.40	7.73	7.73	7.73	0.30	0.86	± 12.0 %
2300	39.5	1.67	7.59	7.59	7.59	0.30	0.90	± 12.0 %
2450	39.2	1.80	7.33	7.33	7.33	0.30	0.90	± 12.0 %
2600	39.0	1.96	7.24	7.24	7.24	0.36	0.90	± 12.0 %
5200	36.0	4.66	5.25	5.25	5.25	0.40	1.80	± 13.1 %
5300	35.9	4.76	5.09	5.09	5.09	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.55	4.55	4.55	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.46	4.46	4.46	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.65	4.65	4.65	0.40	1.80	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

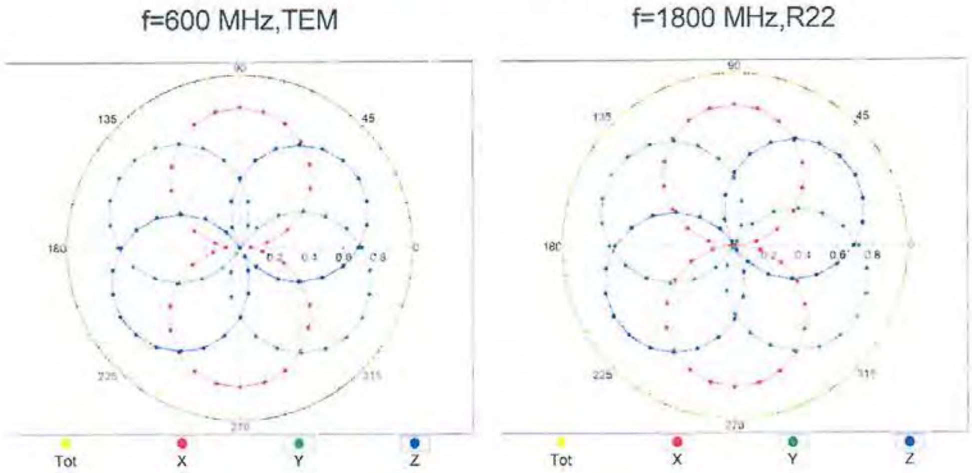
Frequency Response of E-Field

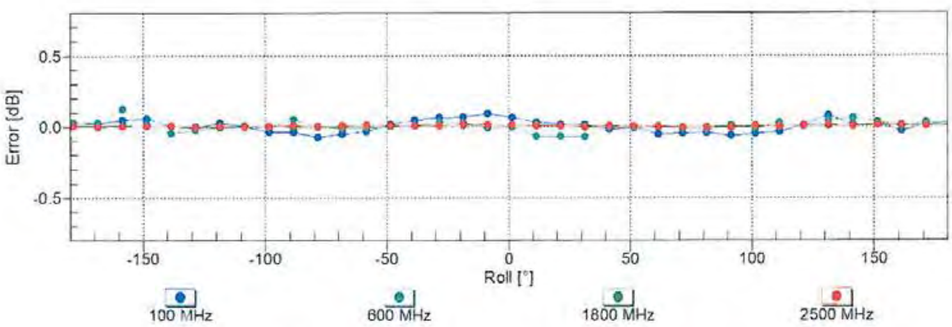
(TEM-Cell:ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), ϑ = 0°

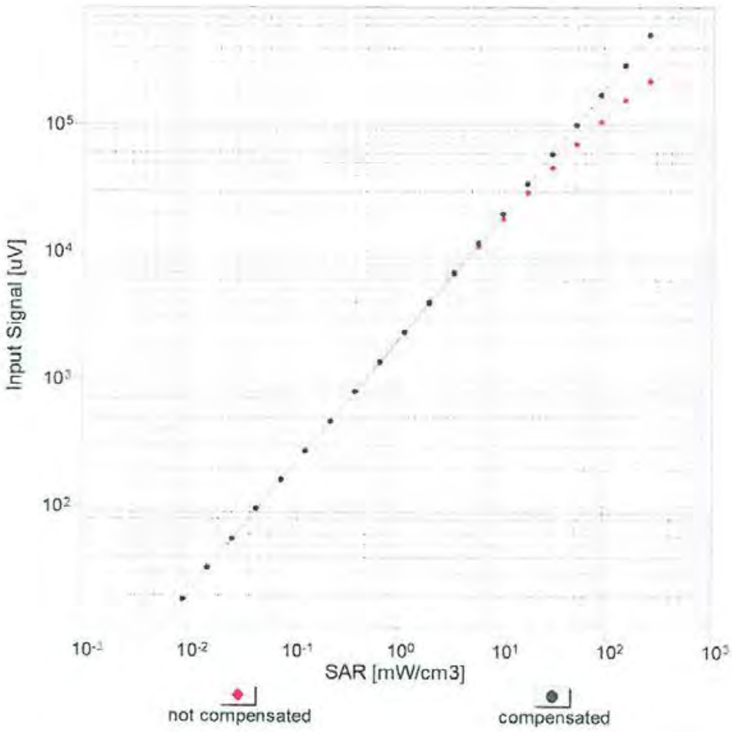


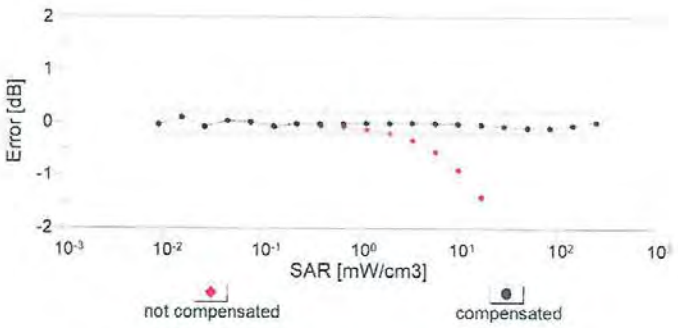


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

EX3DV4– SN:3866 April 29, 2022

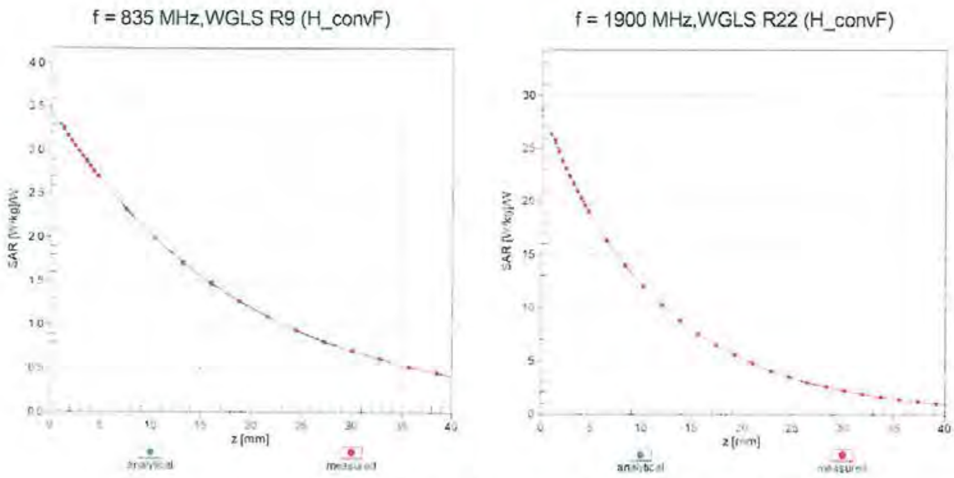
Dynamic Range f(SAR$_{head}$)
(TEM cell , f_{eval}= 1900 MHz)





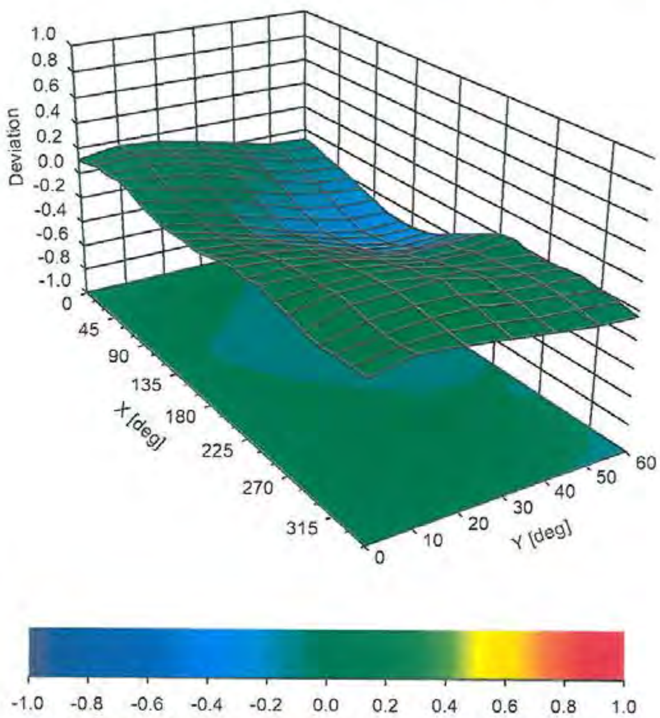
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

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Accreditation No.: **SCS 0108**

Client **DT&C (Dymstec)**

Certificate No: **EX3-7368_Nov21**

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:7368

Calibration procedure(s): QA CAL-01.v9, QA CAL-14.v6, QA CAL-23.v5, QA CAL-25.v
Calibration procedure for dosimetric E-field probes

Calibration date: November 22, 2021

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
Reference 20 dB Attenuator	SN: CC2552 (20x)	09-Apr-21 (No. 217-03343)	Apr-22
DAE4	SN: 660	23-Dec-20 (No. DAE4-660_Dec20)	Dec-21
Reference Probe ES3DV2	SN: 3013	30-Dec-20 (No. ES3-3013_Dec20)	Dec-21
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-20)	In house check: Jun-22
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-20)	In house check: Jun-22
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-22

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	[signature]
Approved by:	Niels Kuster	Quality Manager	[signature]

Issued: November 24, 2021

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Certificate No: EX3-7368_Nov21 Page 1 of 23

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Accreditation No.: **SCS 0108**

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7368

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m)^2)[A]	0.48	0.56	0.42	± 10.1 %
DCP (mV)[B]	101.2	100.0	101.0	

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB√µV	C	D dB	VR mV	Max dev.	Max Unc[E] (k=2)
0	CW	X	0.00	0.00	1.00	0.00	134.3	± 2.5 %	± 4.7 %
		Y	0.00	0.00	1.00		147.0		
		Z	0.00	0.00	1.00		131.3		
10352-AAA	Pulse Waveform (200Hz, 10%)	X	2.20	64.87	9.52	10.00	60.0	± 3.8 %	± 9.6 %
		Y	4.28	71.93	13.04		60.0		
		Z	2.35	65.26	9.69		60.0		
10353-AAA	Pulse Waveform (200Hz, 20%)	X	1.42	64.01	8.32	6.99	80.0	± 2.6 %	± 9.6 %
		Y	12.14	82.95	15.42		80.0		
		Z	1.47	64.48	8.48		80.0		
10354-AAA	Pulse Waveform (200Hz, 40%)	X	1.24	66.34	8.61	3.98	95.0	± 1.3 %	± 9.6 %
		Y	20.00	89.33	16.24		95.0		
		Z	1.30	67.14	8.85		95.0		
10355-AAA	Pulse Waveform (200Hz, 60%)	X	20.00	87.03	14.16	2.22	120.0	± 0.9 %	± 9.6 %
		Y	20.00	92.54	16.72		120.0		
		Z	20.00	88.50	14.66		120.0		
10387-AAA	QPSK Waveform, 1 MHz	X	1.69	66.67	15.23	1.00	150.0	± 2.0 %	± 9.6 %
		Y	1.64	65.25	14.34		150.0		
		Z	1.64	67.79	15.39		150.0		
10388-AAA	QPSK Waveform, 10 MHz	X	2.23	68.18	15.89	0.00	150.0	± 1.2 %	± 9.6 %
		Y	2.16	67.01	15.08		150.0		
		Z	2.12	67.99	15.84		150.0		
10396-AAA	64-QAM Waveform, 100 kHz	X	2.83	70.96	19.01	3.01	150.0	± 0.8 %	± 9.6 %
		Y	2.57	68.31	17.63		150.0		
		Z	2.30	68.32	17.74		150.0		
10399-AAA	64-QAM Waveform, 40 MHz	X	3.53	67.31	15.88	0.00	150.0	± 0.9 %	± 9.6 %
		Y	3.34	66.03	15.14		150.0		
		Z	3.31	66.57	15.53		150.0		
10414-AAA	WLAN CCDF, 64-QAM, 40MHz	X	4.69	65.19	15.29	0.00	150.0	± 1.9 %	± 9.6 %
		Y	4.74	65.02	15.14		150.0		
		Z	4.57	65.32	15.34		150.0		

Note: For details on UID parameters see Appendix

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

[A] The uncertainties of Norm X,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7368

Sensor Model Parameters

	C1 fF	C2 fF	α V^{-1}	T1 $ms.V^{-2}$	T2 $ms.V^{-1}$	T3 ms	T4 V^{-2}	T5 V^{-1}	T6
X	41.8	307.23	34.57	8.18	0.00	4.97	1.73	0.05	1.01
Y	44.8	335.07	35.50	6.55	0.00	5.00	0.89	0.21	1.01
Z	31.9	233.24	34.18	6.12	0.00	4.96	1.34	0.00	1.00

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	156.8
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

Note: Measurement distance from surface can be increased to 3-4 mm for an *Area Scan* job.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7368

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
750	41.9	0.89	9.84	9.84	9.84	0.47	0.99	± 12.0 %
835	41.5	0.90	9.52	9.52	9.52	0.51	0.90	± 12.0 %
900	41.5	0.97	9.37	9.37	9.37	0.63	0.80	± 12.0 %
1750	40.1	1.37	8.48	8.48	8.48	0.36	0.86	± 12.0 %
1900	40.0	1.40	8.15	8.15	8.15	0.36	0.86	± 12.0 %
2450	39.2	1.80	7.89	7.89	7.89	0.35	0.90	± 12.0 %
2600	39.0	1.96	7.43	7.43	7.43	0.38	0.90	± 12.0 %
3500	37.9	2.91	7.00	7.00	7.00	0.35	1.30	± 13.1 %
3700	37.7	3.12	6.90	6.90	6.90	0.35	1.30	± 13.1 %
5200	36.0	4.66	5.65	5.65	5.65	0.40	1.80	± 13.1 %
5300	35.9	4.76	5.40	5.40	5.40	0.40	1.80	± 13.1 %
5500	35.6	4.96	5.05	5.05	5.05	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.85	4.85	4.85	0.40	1.80	± 13.1 %
5800	35.3	5.27	5.03	5.03	5.03	0.40	1.80	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

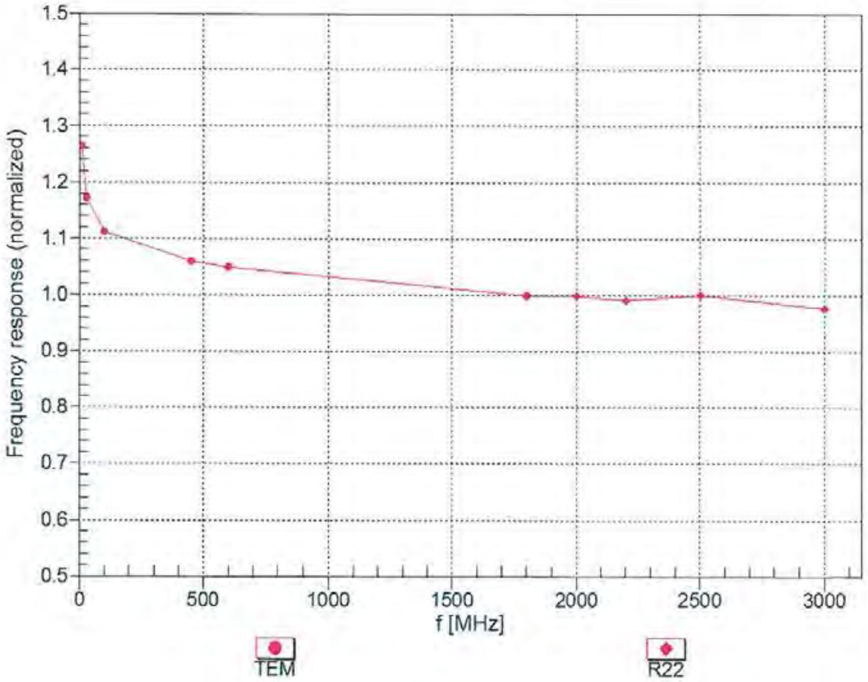
DASY/EASY - Parameters of Probe: EX3DV4 - SN:7368

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
6500	34.5	6.07	5.45	5.45	5.45	0.20	2.50	± 18.6 %

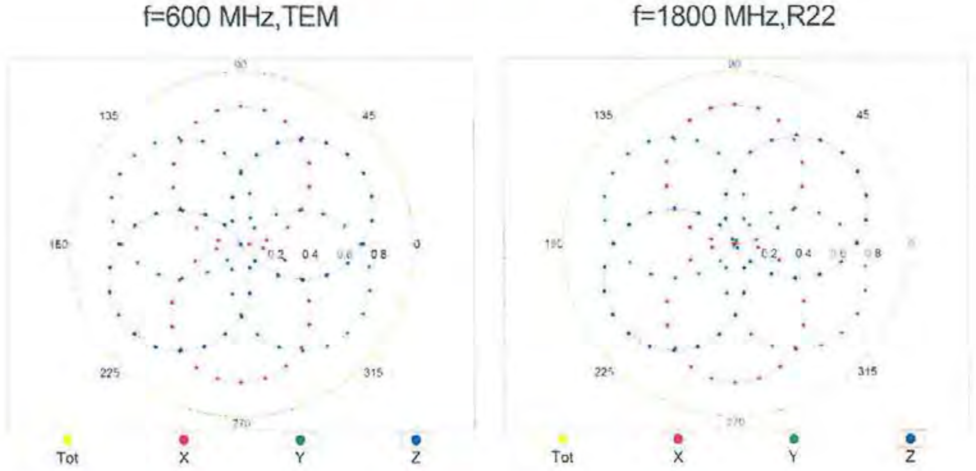
[C] Frequency validity above 6GHz is ± 700 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies 6-10 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz; below ± 2% for frequencies between 3-6 GHz; and below ± 4% for frequencies between 6-10 GHz at any distance larger than half the probe tip diameter from the boundary.

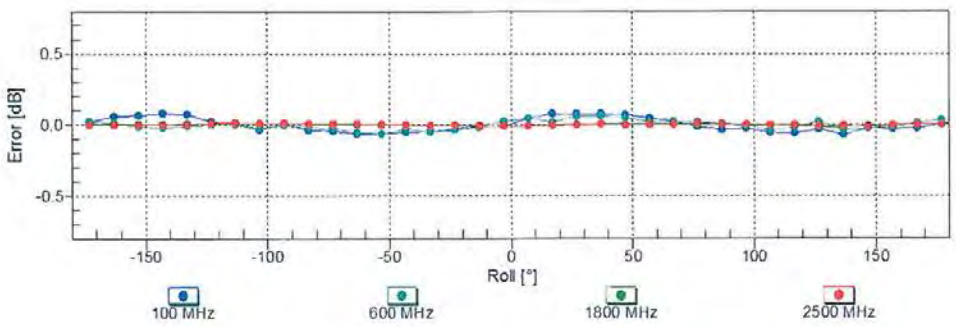
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

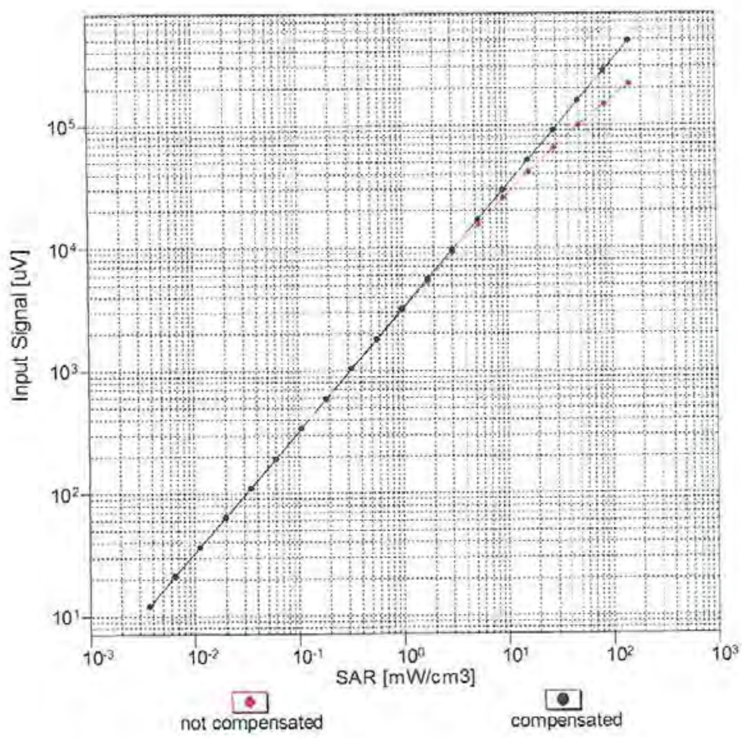
Receiving Pattern (ϕ), ϑ = 0°

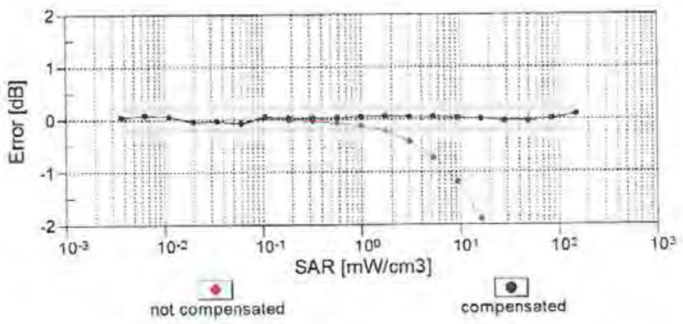




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

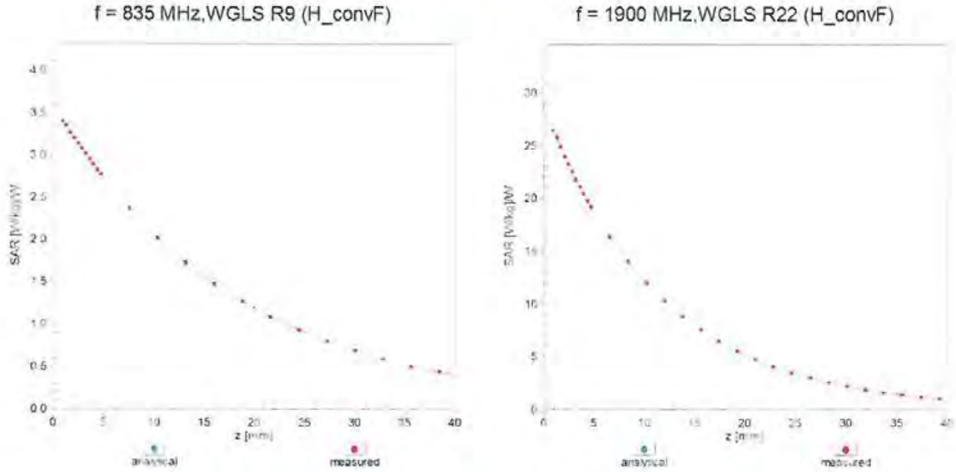
Dynamic Range f(SAR_{head})
(TEM cell , f_{eval}= 1900 MHz)





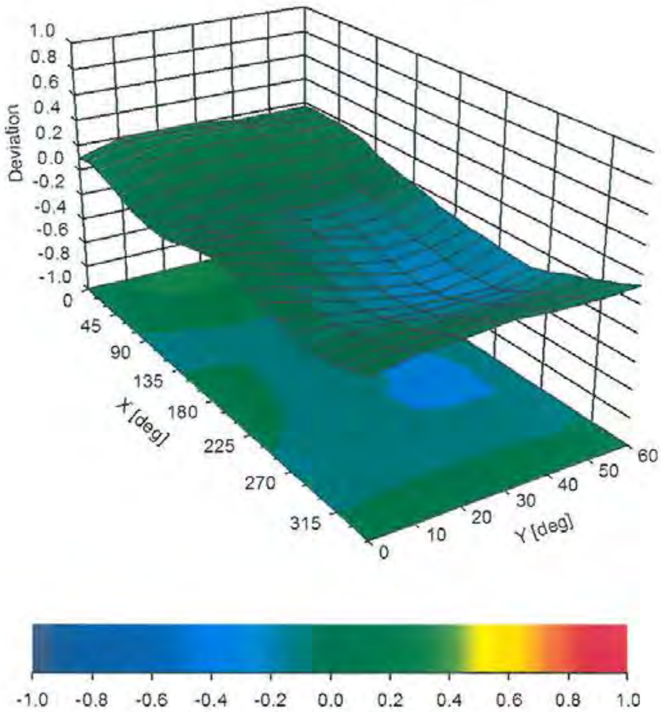
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

Appendix: Modulation Calibration Parameters

UID	Rev	Communication System Name	Group	PAR (dB)	Unc[E] (k=2)
0	-	CW	CW	0.00	± 4.7 %
10010	CAA	SAR Validation (Square, 100ms, 10ms)	Test	10.00	± 9.6 %
10011	CAB	UMTS-FDD (WCDMA)	WCDMA	2.91	± 9.6 %
10012	CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	WLAN	1.87	± 9.6 %
10013	CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps)	WLAN	9.46	± 9.6 %
10021	DAC	GSM-FDD (TDMA, GMSK)	GSM	9.39	± 9.6 %
10023	DAC	GPRS-FDD (TDMA, GMSK, TN 0)	GSM	9.57	± 9.6 %
10024	DAC	GPRS-FDD (TDMA, GMSK, TN 0-1)	GSM	6.56	± 9.6 %
10025	DAC	EDGE-FDD (TDMA, 8PSK, TN 0)	GSM	12.62	± 9.6 %
10026	DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1)	GSM	9.55	± 9.6 %
10027	DAC	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	GSM	4.80	± 9.6 %
10028	DAC	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	GSM	3.55	± 9.6 %
10029	DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1-2)	GSM	7.78	± 9.6 %
10030	CAA	IEEE 802.15.1 Bluetooth (GFSK, DH1)	Bluetooth	5.30	± 9.6 %
10031	CAA	IEEE 802.15.1 Bluetooth (GFSK, DH3)	Bluetooth	1.87	± 9.6 %
10032	CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	Bluetooth	1.16	± 9.6 %
10033	CAA	IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH1)	Bluetooth	7.74	± 9.6 %
10034	CAA	IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH3)	Bluetooth	4.53	± 9.6 %
10035	CAA	IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH5)	Bluetooth	3.83	± 9.6 %
10036	CAA	IEEE 802.15.1 Bluetooth (8-DPSK, DH1)	Bluetooth	8.01	± 9.6 %
10037	CAA	IEEE 802.15.1 Bluetooth (8-DPSK, DH3)	Bluetooth	4.77	± 9.6 %
10038	CAA	IEEE 802.15.1 Bluetooth (8-DPSK, DH5)	Bluetooth	4.10	± 9.6 %
10039	CAB	CDMA2000 (1xRTT, RC1)	CDMA2000	4.57	± 9.6 %
10042	CAB	IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Halfrate)	AMPS	7.78	± 9.6 %
10044	CAA	IS-91/EIA/TIA-553 FDD (FDMA, FM)	AMPS	0.00	± 9.6 %
10048	CAA	DECT (TDD, TDMA/FDM, GFSK, Full Slot, 24)	DECT	13.80	± 9.6 %
10049	CAA	DECT (TDD, TDMA/FDM, GFSK, Double Slot, 12)	DECT	10.79	± 9.6 %
10056	CAA	UMTS-TDD (TD-SCDMA, 1.28 Mcps)	TD-SCDMA	11.01	± 9.6 %
10058	DAC	EDGE-FDD (TDMA, 8PSK, TN 0-1-2-3)	GSM	6.52	± 9.6 %
10059	CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps)	WLAN	2.12	± 9.6 %
10060	CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps)	WLAN	2.83	± 9.6 %
10061	CAB	IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps)	WLAN	3.60	± 9.6 %
10062	CAD	IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps)	WLAN	8.68	± 9.6 %
10063	CAD	IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps)	WLAN	8.63	± 9.6 %
10064	CAD	IEEE 802.11a/h WiFi 5 GHz (OFDM, 12 Mbps)	WLAN	9.09	± 9.6 %
10065	CAD	IEEE 802.11a/h WiFi 5 GHz (OFDM, 18 Mbps)	WLAN	9.00	± 9.6 %
10066	CAD	IEEE 802.11a/h WiFi 5 GHz (OFDM, 24 Mbps)	WLAN	9.38	± 9.6 %
10067	CAD	IEEE 802.11a/h WiFi 5 GHz (OFDM, 36 Mbps)	WLAN	10.12	± 9.6 %
10068	CAD	IEEE 802.11a/h WiFi 5 GHz (OFDM, 48 Mbps)	WLAN	10.24	± 9.6 %
10069	CAD	IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps)	WLAN	10.56	± 9.6 %
10071	CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 9 Mbps)	WLAN	9.83	± 9.6 %
10072	CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 12 Mbps)	WLAN	9.62	± 9.6 %
10073	CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 18 Mbps)	WLAN	9.94	± 9.6 %
10074	CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 24 Mbps)	WLAN	10.30	± 9.6 %
10075	CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 36 Mbps)	WLAN	10.77	± 9.6 %
10076	CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 48 Mbps)	WLAN	10.94	± 9.6 %
10077	CAB	IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps)	WLAN	11.00	± 9.6 %
10081	CAB	CDMA2000 (1xRTT, RC3)	CDMA2000	3.97	± 9.6 %
10082	CAB	IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Fullrate)	AMPS	4.77	± 9.6 %
10090	DAC	GPRS-FDD (TDMA, GMSK, TN 0-4)	GSM	6.56	± 9.6 %
10097	CAB	UMTS-FDD (HSDPA)	WCDMA	3.98	± 9.6 %
10098	CAB	UMTS-FDD (HSUPA, Subtest 2)	WCDMA	3.98	± 9.6 %
10099	DAC	EDGE-FDD (TDMA, 8PSK, TN 0-4)	GSM	9.55	± 9.6 %